611 TRAFFIC SIGNAL NEEDS STUDIES

The overall objective of traffic signal control is to provide an equitable balance of safe and efficient movements of traffic and pedestrian volumes through the intersection. Although most of the steps in conducting a traffic signal needs study are quantitative, the final determination of recommending whether traffic signal controls should be provided at a particular location involves a qualitative assessment which requires engineering judgment. If the particular location being studied satisfies one or more of the eleven MUTCD warrants, one of the most important qualitative assessments the traffic engineer should consider before justifying traffic signal control is a remedy that is less restrictive than signalizing the intersection.

Some of the less restrictive remedies that should be considered are:

A. Geometric improvements such as the addition of turn lanes either by construction or by restriping the existing cross section;

B. Sight obstruction removal to increase intersection sight distance;

C. Street lighting if nighttime accidents are predominant; and

D. Improved signing and pavement markings to better define the intersection and its operational characteristics.

A traffic signal needs study shall be conducted to determine if a traffic signal should be provided at a particular location. The signal needs study should include a comprehensive investigation of traffic conditions and the physical characteristics of the location. The following data and/or analyses may be included in the study as appropriate to the specific situation:

A. A signal warrant analysis (required)

B. A 24-hour turning movement count which includes all entering traffic volumes and movement direction, AM and PM peak hour traffic volumes and movement direction, and pedestrian volumes; the percentage of trucks and buses should be considered where appropriate. A 24-hour turning movement count should be obtained by applying factors of 1.35 and 1.20 to 12 or 16 hours, respectively, of turning movement count data collected in the field.

C. A traffic collision study including a summary by type and severity with a collision diagram

D. A condition diagram which includes roadway geometrics, parking, driveways, sidewalks, signing, pavement markings, development of intersection quadrants, and any other features pertinent to the study

E. A peak hour delay study

F. A conflict analysis

G. Approach speed limits and/or approach speeds

H. Analysis of the existing progression in a coordinated system

I. A capacity analysis

J. Traffic volume projections for new roadways (see Figure 611-A)

K. Traffic signal priority evaluation (see Figure 611-B)

L. Other data which are desirable for a more precise understanding of the operation of the intersection

On new roadways scheduled for construction, it is occasionally necessary to project signal warrants to determine whether signals should be considered for inclusion in the initial construction project. There is a simple approach to projecting signal volume warrants. The following steps provide a solid, although theoretical, basis for deciding whether or not signals should be incorporated in the design:

A. Obtain a traffic projection from the Transportation Planning Group, Travel and Facilities Section, or from any other reliable source of data, for three years beyond the anticipated completion of construction.

B. Determine whether full warrants or 70 percent warrants are appropriate for the location.

C. Multiply the projected AADT by 5.72 percent.[1] The resultant volumes are reasonable approximations of the eighth highest hourly volumes; thus, if the calculated volumes exceed the warrant values, the location could technically be considered for signalization.

D. To fill in a "Projected Volumes" warrant sheet, multiply the projected AADT by the following factors:

High Hour	Hourly Adjustment Factor [2]
1	.0771
4	.0656
8	.0572

1 Pignataro, Louis J., Traffic Engineering, (Prentice-Hall, Englewood Cliffs), 1973, page 158.

2 Ibid.

FIGURE 611-A
TRAFFIC VOLUME PROJECTIONS FOR NEW ROADWAYS

TRAFFIC SIGNAL PRIORITY EVALUATION

Location:_____ Date:_____

1. **Frequency of accidents susceptible to correction by signalization - Award 15 points** if the yearly average of right angle collisions over the 3-year evaluation period is more than 5 per year. **Award 10 points** if the yearly average is 4 to 5 per year and **award 5 points** if the yearly average is 3 to 4 angle collisions per year.

2. **Vehicle volumes in excess of warrant minimums (Volume warrants 1 and 2) - Award 1 point** for each hour that the high volume minor street approach exceeds 200% of stated values for volume warrants. _____

3. **Peak hour stopped time delay for volume on high volume minor street approach - Award points** if the average delay per vehicle measured at the subject location is equal to or more than the stated delay value given for the appropriate roadway environment: _____

	Rural Environment *	Urban Environment *
5 points	= > 15 sec./veh.	> 20 sec./veh.
10 points	= > 20 sec./veh.	> 30 sec./veh.
15 points	= > 30 sec./veh.	> 35 sec./veh.

* The subject location may have a combination of both urban and rural characteristics. The evaluator should use engineering judgment in choosing the proper classification. Some parameters to consider in classifying the roadway environment along the major route are listed below:

Rural - 2-lane, random arrival rate at intersection, high speeds, little to medium development, low to medium ADT, low number of access points.

Urban - 4-lane, fairly uniform arrival rate at intersection, low speeds, medium to heavy development, medium to high ADT, significant number of access points.

4. **Intersection geometrics - Award 10 points** if geometric or physical constraints at the intersection make cross-corner sight distance inadequate for the minor leg traffic and that no cost-effective, remedial measure can be realized to correct it. This includes sight restrictions due to vertical or horizontal alignments, buildings or permanent structures within sight distance triangle, etc. _____

5. **Progressive system compatibility - Award 10 points** if the intersection is within an existing progressive system or spacing between adjacent traffic signals and the study location is not less than 1000 feet. **Deduct 10 points** if the study location is less than 1000 feet from an existing signal. **No points** if the intersection is considered stand alone (one-half mile from any adjacent signal). _____

GRAND TOTAL _____

FIGURE 611-B
TRAFFIC SIGNAL PRIORITY EVALUATION

Videotaping of the study location is recommended for future reference, evaluation, interpretation, and for an archive of the intersection.

When conducting a traffic signal warrant analysis, the number of lanes on each approach should normally be considered as the number of through traffic lanes, excluding left turn and right turn lanes, except at T-intersections.

For a minor street approach with one through lane plus a left-turn lane, engineering judgment would indicate that it should be considered a one-lane approach if the traffic using the left-turn lane is minor. In such a case, judgment would also indicate that only the volume of traffic in the through/right-turn lane should be considered against the volume warrants. Conversely, it would be considered as a two-lane approach if the lane split approached 50/50.

The ability of traffic to make right turns on red, without right-of-way assignment, may reduce the benefit realized from a traffic signal if one is installed. Therefore, the effect of right turn vehicles from minor street approaches should be considered when volume warrants are being applied. Engineering judgment should be used to determine what portion, if any, of the right turn traffic can be subtracted from the higher-volume minor street traffic count.

The following guide should be used to reduce the number of right-turning vehicles per hour on minor street approaches:

> The adjusted right turn volume equals the total right turn volume minus the right turn volume experiencing a stopped-delay measurement of five seconds or less on the higher volume minor street approach:

$$\text{adjusted right turn vol.} = (\text{total right turn vol.}) - (\text{right turn vol. w/ delay of 5 secs. or less})$$

> The reduction factor for the peak hour may be applied to both minor street approaches for the remaining hours of the turning movement count:

$$\text{reduction factor} = \frac{\text{(adjusted right turn vol.)}}{\text{(total right turn vol.)}}$$

The signal needs study should take into account all relevant factors and not just the signal warrants alone in determining the justification for a traffic signal. The fact that a location numerically meets a signal warrant does not necessarily mean that a signal is justified. For instance, a location may meet the minimum volume warrant, but, because of a heavy right-turn movement, vehicles on the minor street may experience very little delay and may not really need a traffic signal.

It must be remembered that one may trade one type of collision for another when a traffic signal is installed. One can expect that the number of angle collisions will be reduced; however, since traffic on the main street will now be required to stop, the probability of rear-end collisions occurring increases dramatically. Therefore, during the study, a detailed analysis should be made of the collisions which have occurred. The collision analysis should include at least three years of data to ensure that collision patterns can be differentiated from sporadic or random collision patterns of short duration.

If a traffic signal is justified, the signal needs study should include an analysis of the need for and the location of pedestrian signals, pedestrian push-buttons, and marked crosswalks.

If a traffic signal is justified, the signal needs study should include what type of geometric improvements, if any, are required prior to installing a traffic signal.

The signal needs study should indicate who prepared and who approved the study. Typical examples of signal needs studies may be obtained from the Traffic Design Section.

The signal needs study shall be prepared under the guidance of a registered professional engineer and shall be stamped. For installation consideration, the study shall be submitted to the Traffic Engineering Group.